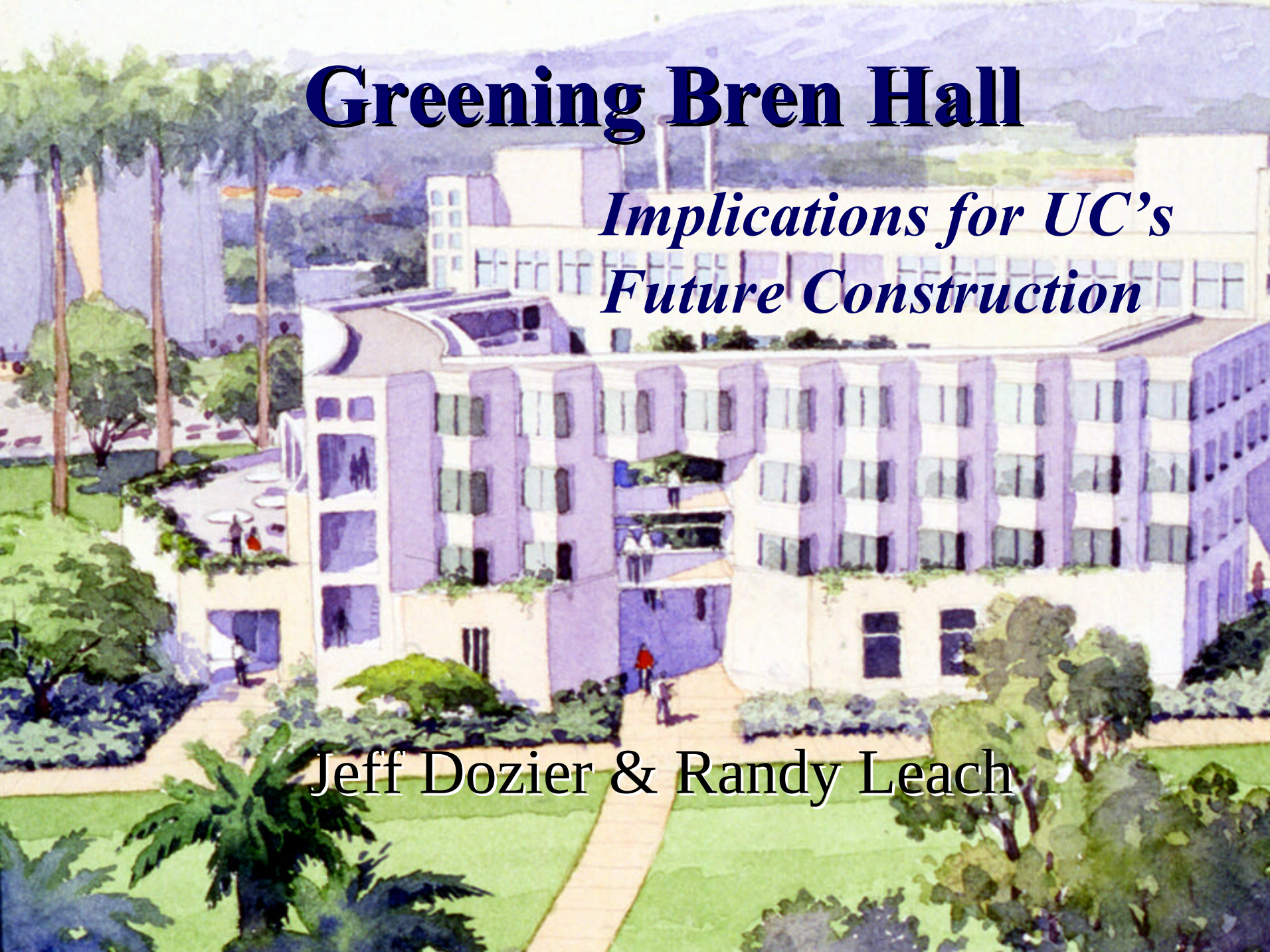


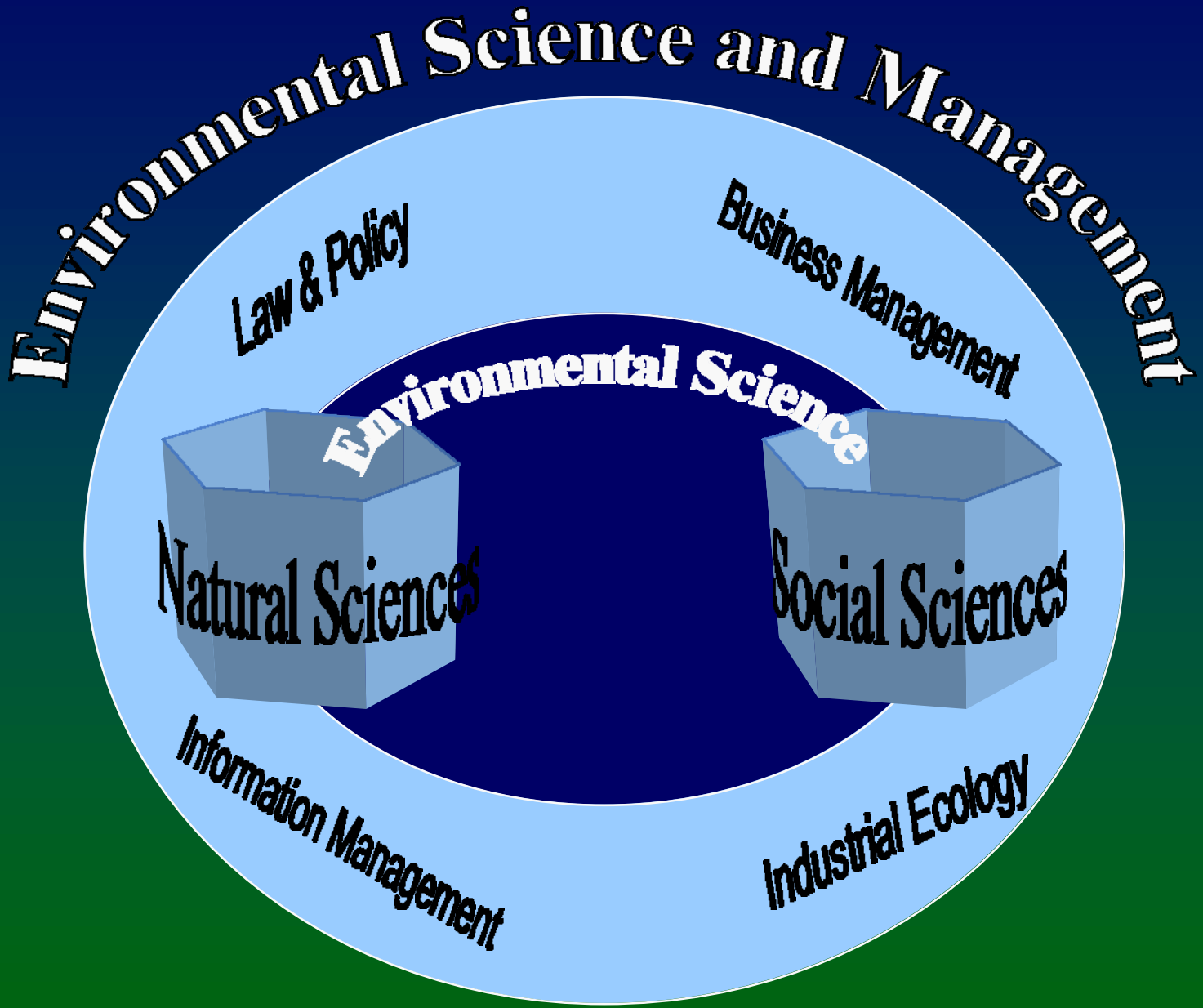
# Greening Bren Hall

## *Implications for UC's Future Construction*

Jeff Dozier & Randy Leach

# The Bren School's mission …

- … is to play a leading role in training professionals and research scientists, discovering new knowledge about environmental issues, and identifying and solving environmental problems


Environmental Science and Management
Law & Policy
Business Management
Environmental Science
Natural Sciences
Social Sciences
Information Management
Industrial Ecology

# Chronology — Academic

- 1991: UC Regents approve formation of the School of Environmental Science and Management
- 1992: Dean search begins
- 1995: First faculty hires
- 1994: Founding Dean appointed
- 1996: First master's class admitted
- 1997: Bren gift, change name to Bren School
- 1998: First PhD students admitted
- 1999: MBA concentration
- 2000: Third master's class graduates

# The Bren School's degree programs

- MESM, Fall '96
  - 2-year professional degree, for students who will work in government agencies, corporations, non-profit organizations, and consulting firms
- MBA concentration, Fall '99
  - Emphasis in corporate environmental management for students in UC business schools
- PhD, Fall '98
  - Build the natural and social science knowledge bases
  - Evaluate and design environmental policies
  - Preparation for academic and non-academic careers

# Ideal graduate

- *Knowledge* of environmental science and management, with expertise in a specialty area
- Technical and "soft" *Skills,* including statistics, computing, project management, teamwork, …
- Professional *Qualities*, including creativity, leadership, judgment, integrity, ability to handle difficult situations, …

# Sustainable Design for the University

## Principles

- Don’t scar the Earth
- Don’t make people sick
  - In manufacturing of materials
  - In use of building
  - After use of building
- Don’t pollute the air and water

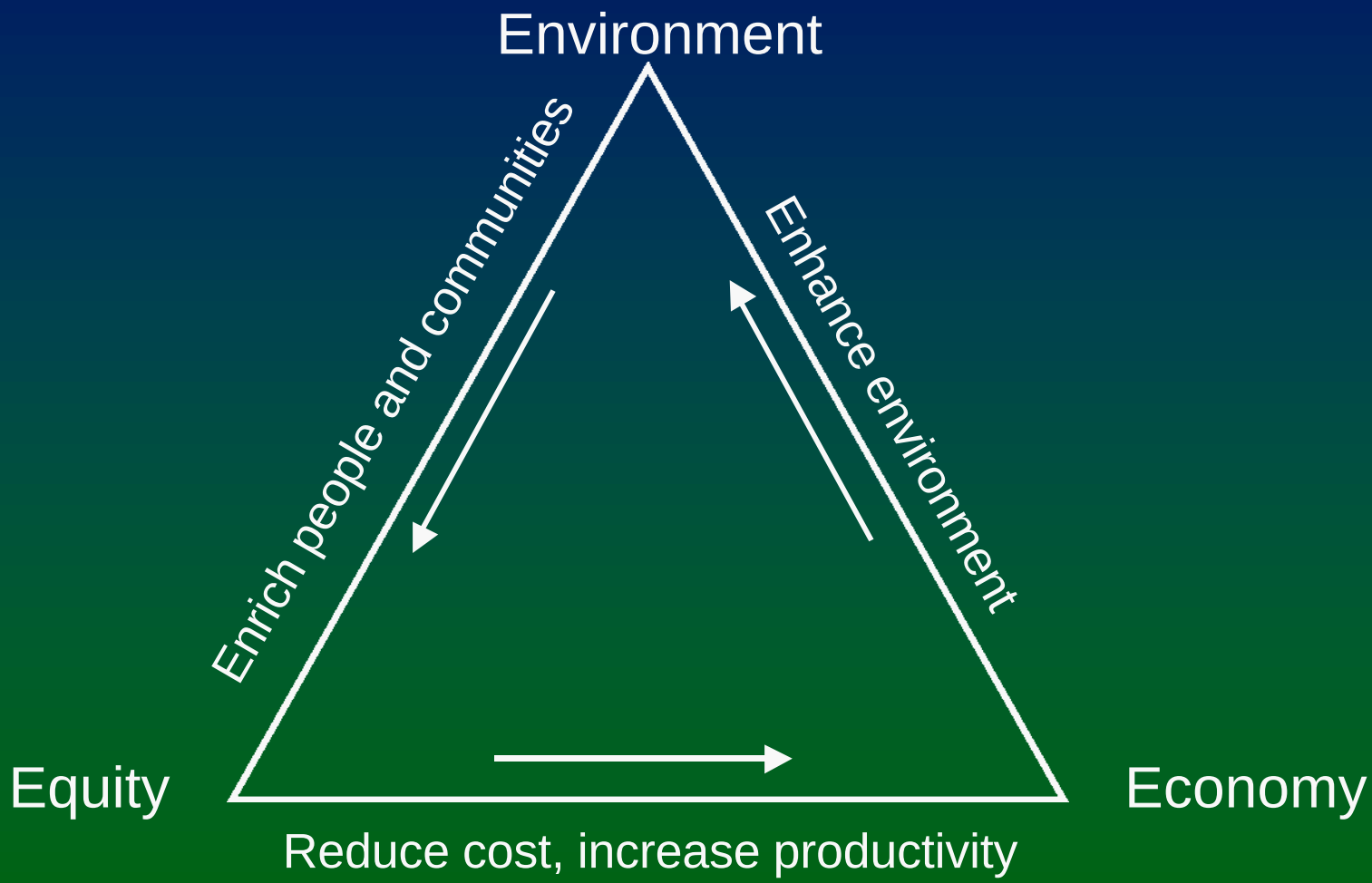
## Guidelines

- Sustainable sites
- Water efficiency & quality
- Energy efficiency & air quality
- Materials and resources
- Indoor environmental quality

# LEED Green Building Rating System™ *Version 2*

- LEED – Leadership in Energy and Environmental Design
  - U.S. Green Building Council (www.usgbc.org)
- Set of prerequisites and credits for evaluating a building's sustainability
  - 64 core points + 5 innovation points
  - Certified 26 points, Silver 33 points, Gold 39, Platinum 52

# Considerations



Bren Hall — Third Floor Plan

# Likely LEED Performance for Bren Hall

- Certification: Assured (first UC building)
- Silver Medal: Likely
- Gold Medal: Possible with some additional money (would be first gold-medal building)

# The Cost of Greening

- Design fees
  - Base fees should not increase if goal is upfront
  - Additions for energy modeling and LEED documentation ($40K)
- Construction cost
  - Need to consider total cost of ownership
  - How much is societal benefit worth?
- Owner costs
  - Peer & consultant reviews
  - Additional project management
- Operations and maintenance costs
  - Training needed
  - Should realize cost saving

# Cost Effectiveness

| | |
|---|---|
| Energy savings per year if we implement cost-effective changes | $32,000 |
| Present Value over 10 years @ 6% | $236,000 |
| Bid cost to implement these changes | $148,000 |
| Net Present Value over 10 years @ 6% | $88,000 |
| Carbon emission saved, per year | 54 MT |

# Local Energy Sources

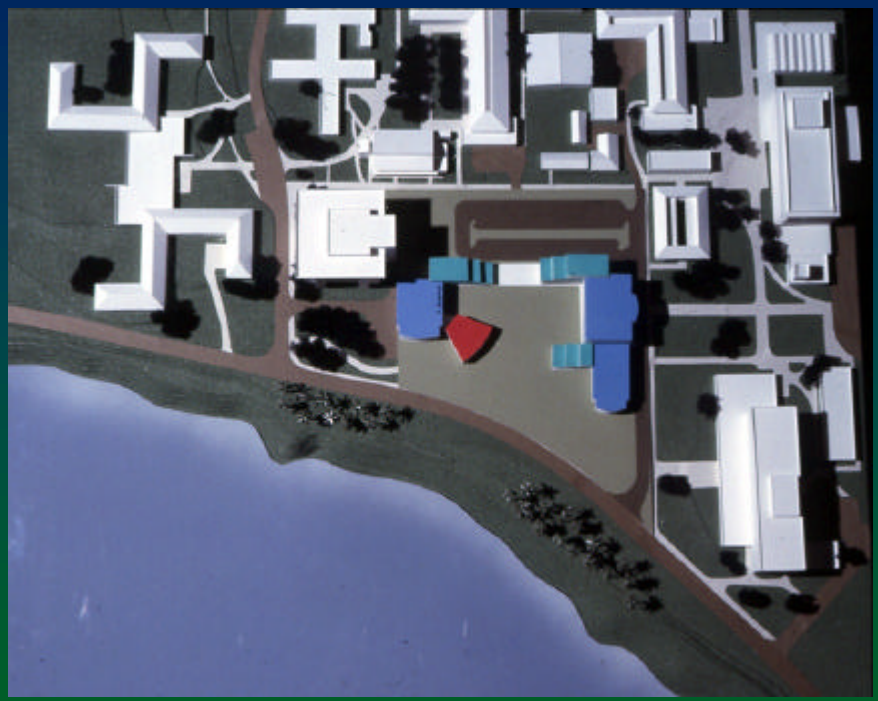
| | Approx cost | CEC buy down | Energy Savings | PV, 6%, 10 years |
|---|---|---|---|---|
| 200 kW fuel cell | $950,000 (incl infr.) | $410,000 | $46,000 | |
| 40 kW PV tiles | $414,200 | $100,000 | $7,000 | |
| | $1,364,200 | ($510,000) $854,000 | $53,000 | $390,000 |

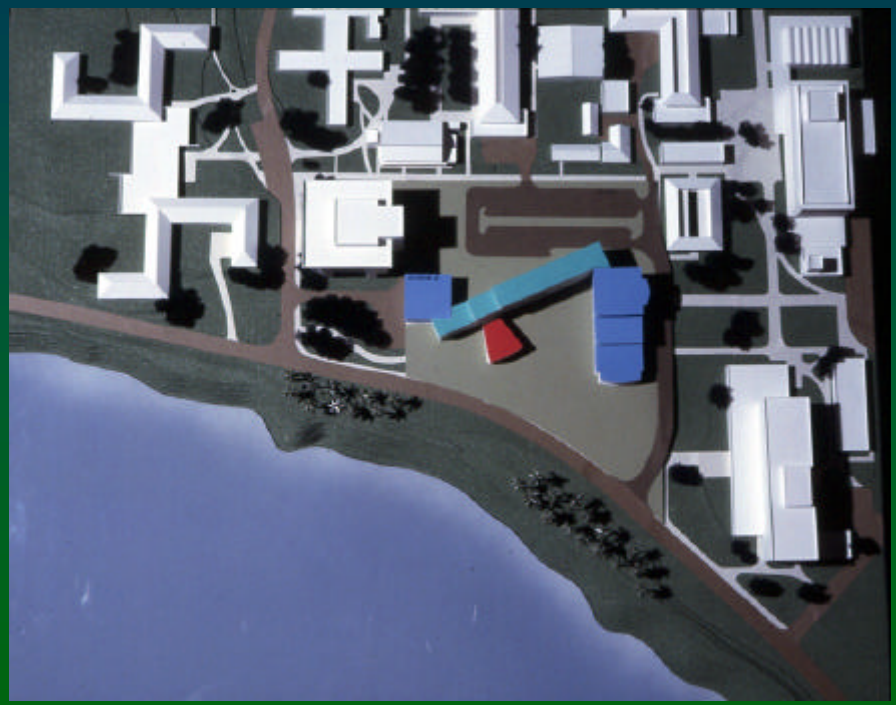
# Funding Sources

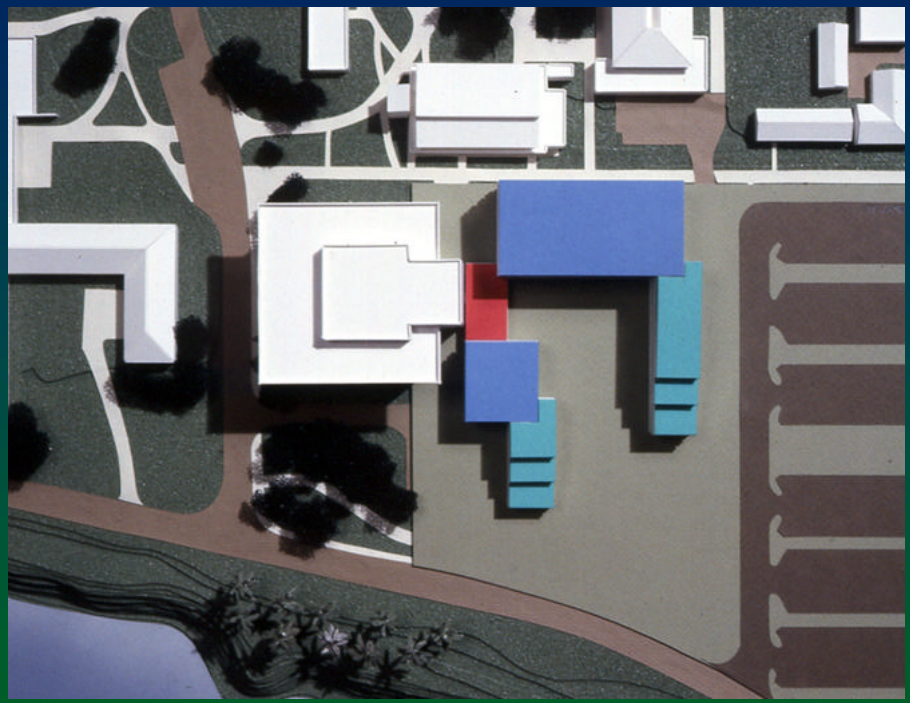
- California Energy Commission
  - Grants for fuel cells, photovoltaics, consultant, post-occupancy programs
  - Loans for energy efficiency
- Vendors
  - Forbo, Milliken, Waterless, Herman Miller, Sarnafil
- Southern California Edison
  - Energy modeling
  - Savings by Design program
    - $250K to owner, $50K to design team
  - Incentives
- Donors
  - Jim Davidson, [Your name goes here]

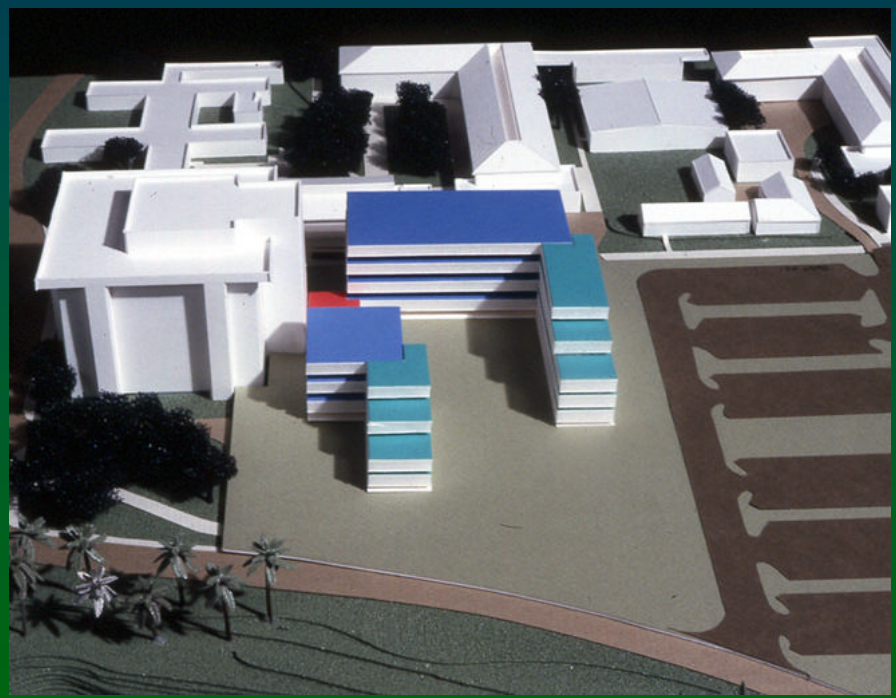
# Affecting the Future—Campus Standards

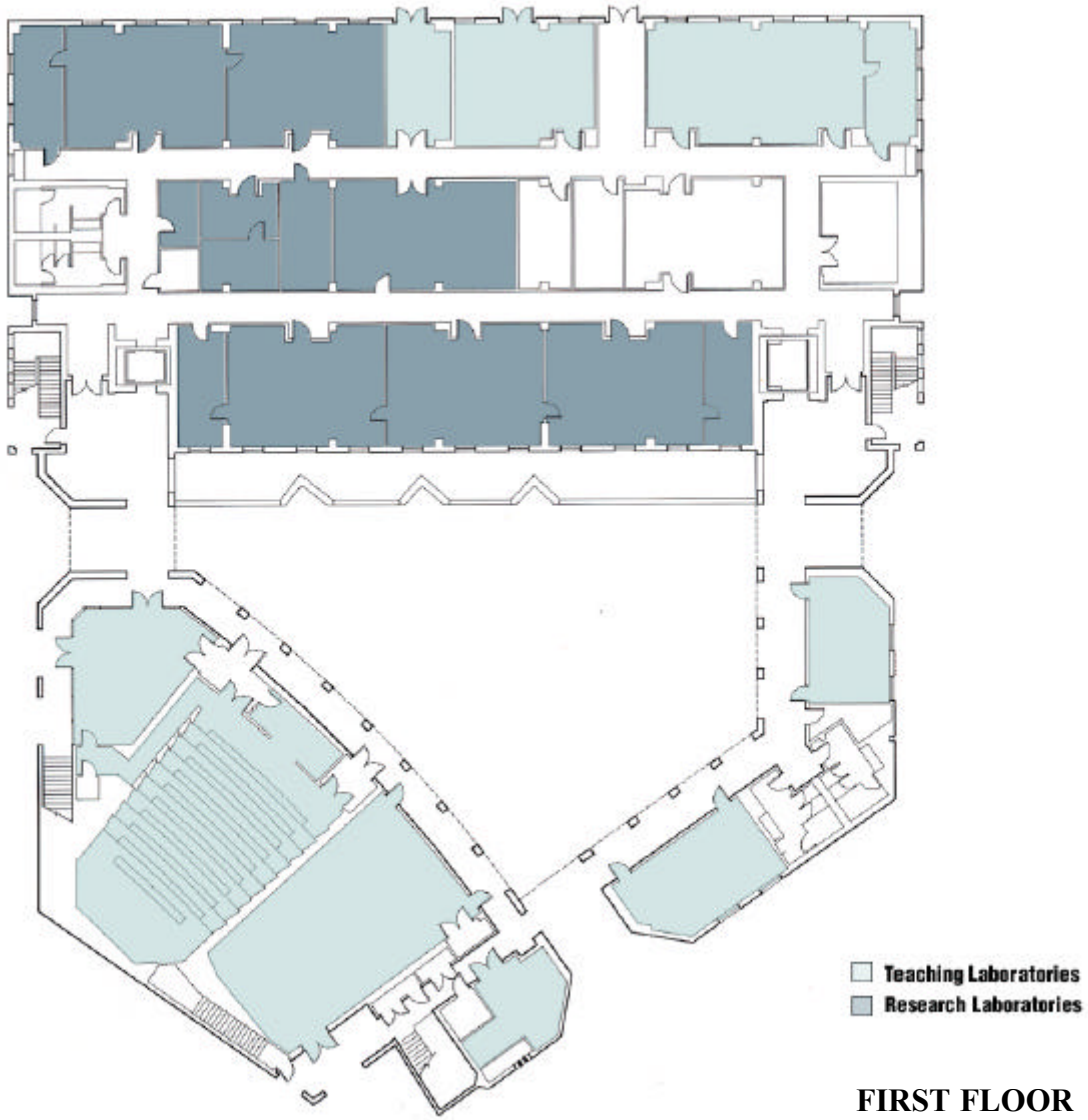
- Policy needed
  - Chancellor, Academic Senate
  - Earlier Start
- Part of personnel processes
  - Training, selection and hiring
  - Performance evaluation
- Performance target
  - LEED Certification
  - Audit
- Process
  - Design review
  - Integrated management
  - Cost of ownership & life-cycle costs
  - Environmental accounting



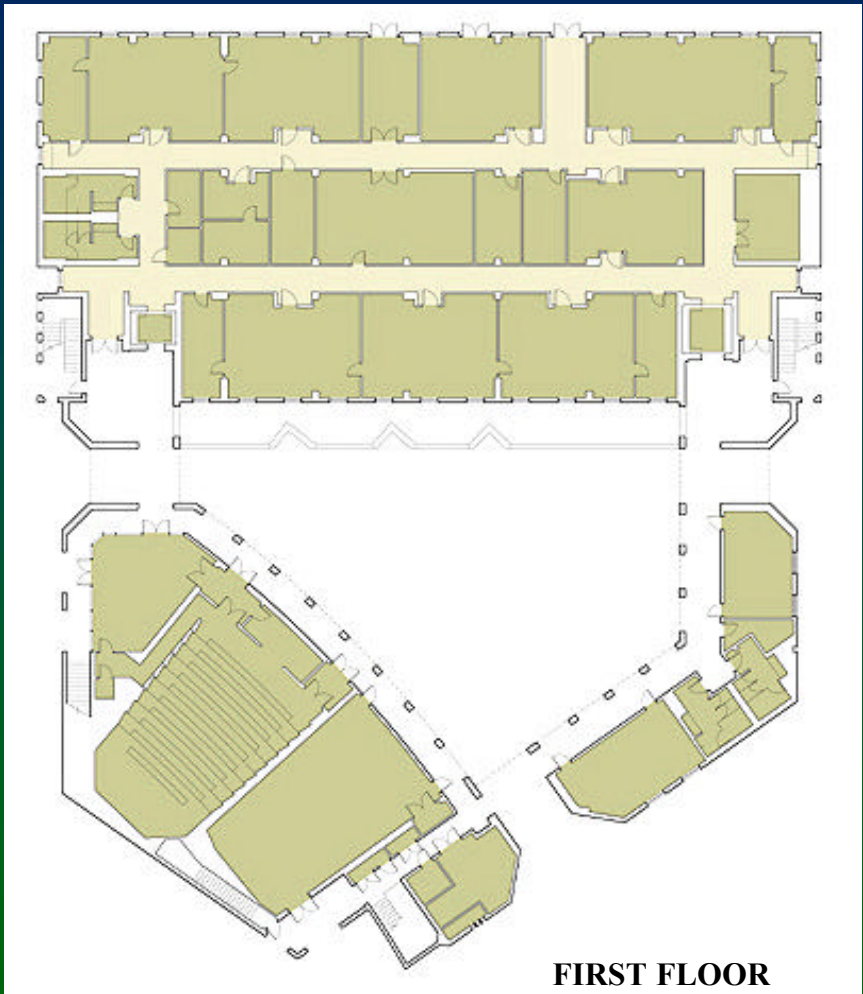




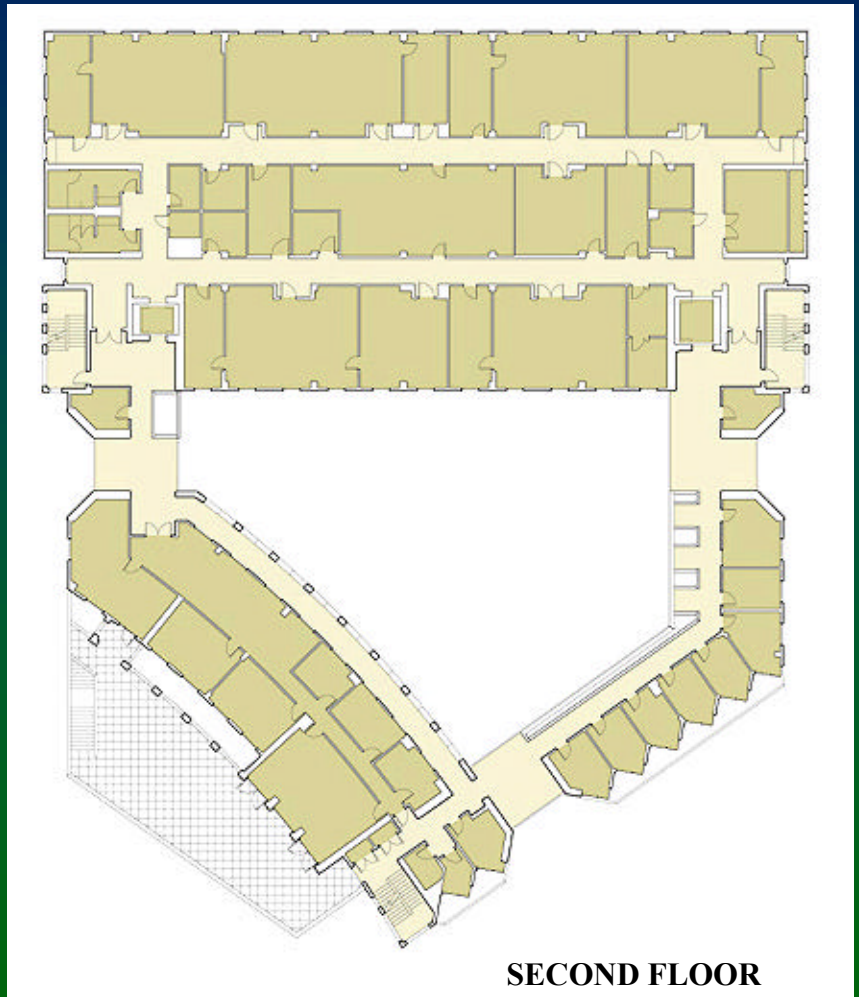




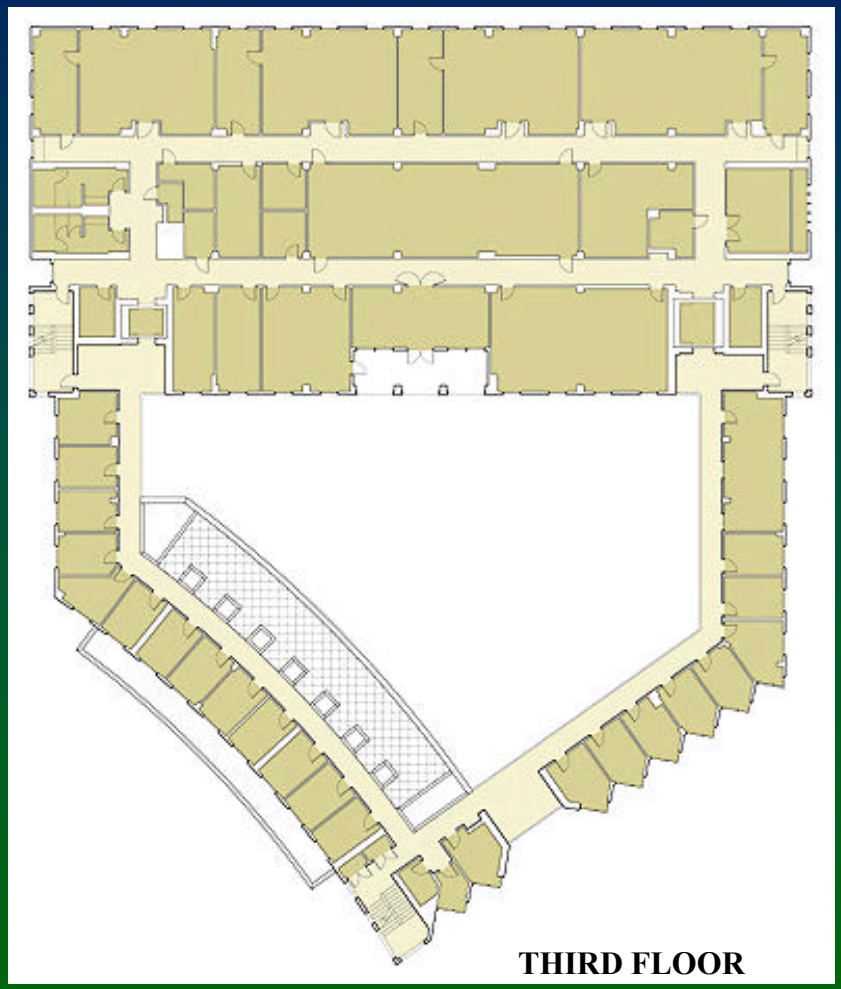

**FIRST FLOOR**



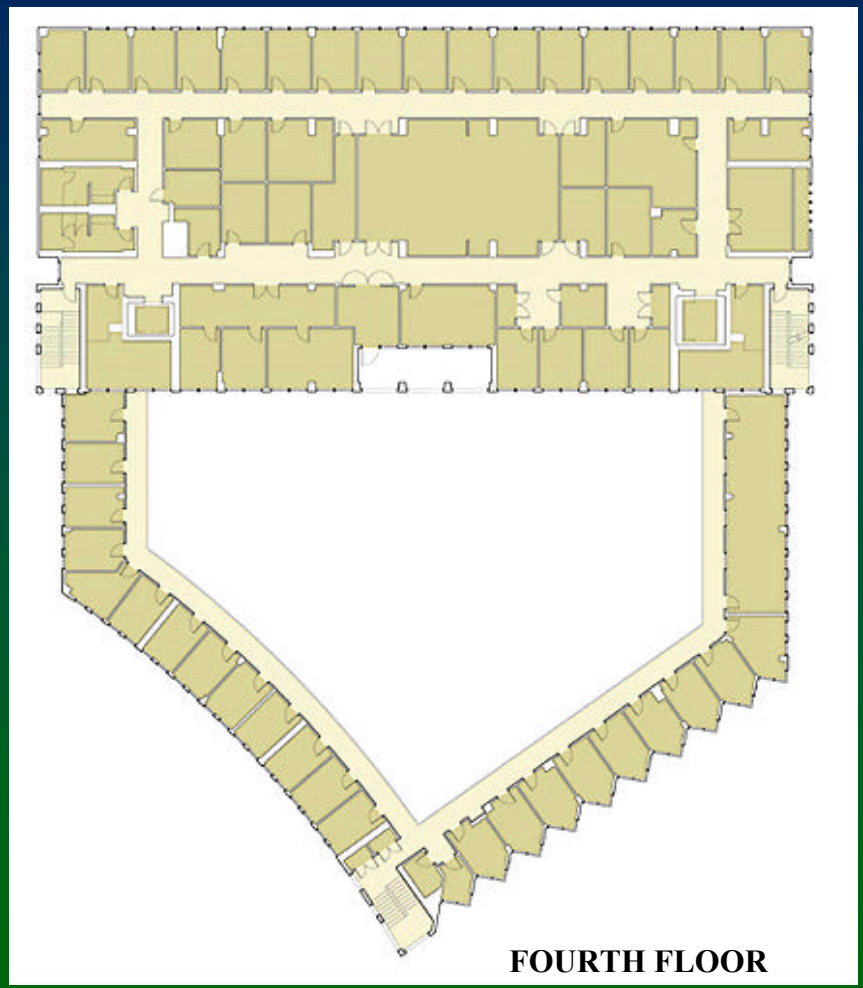
FIRST FLOOR



SECOND FLOOR



THIRD FLOOR

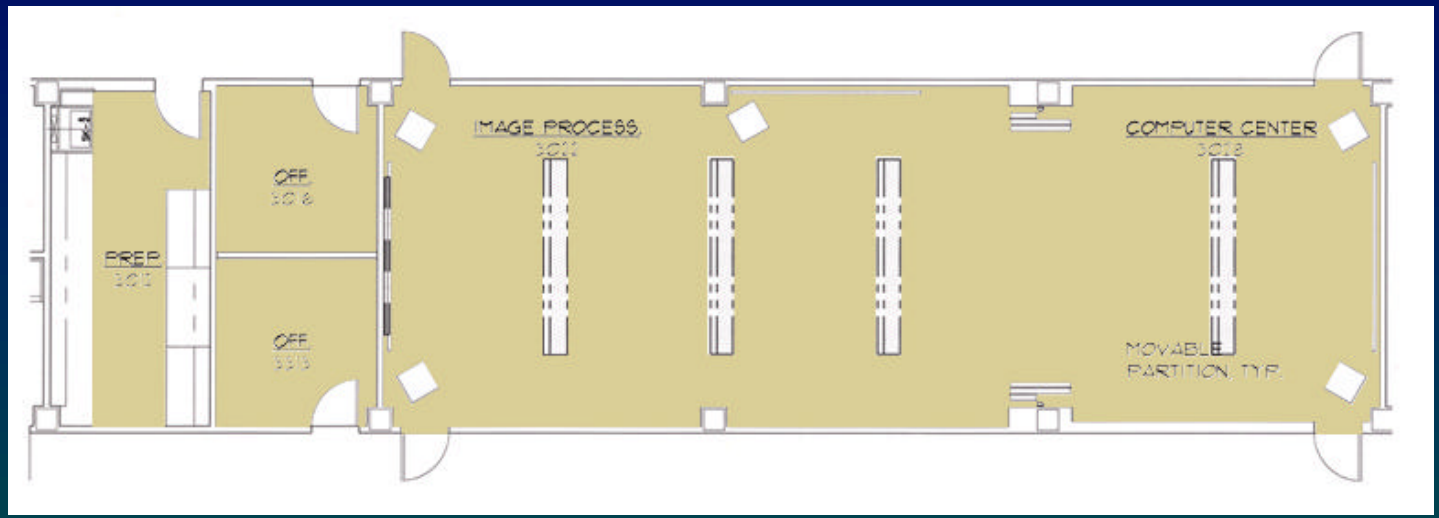


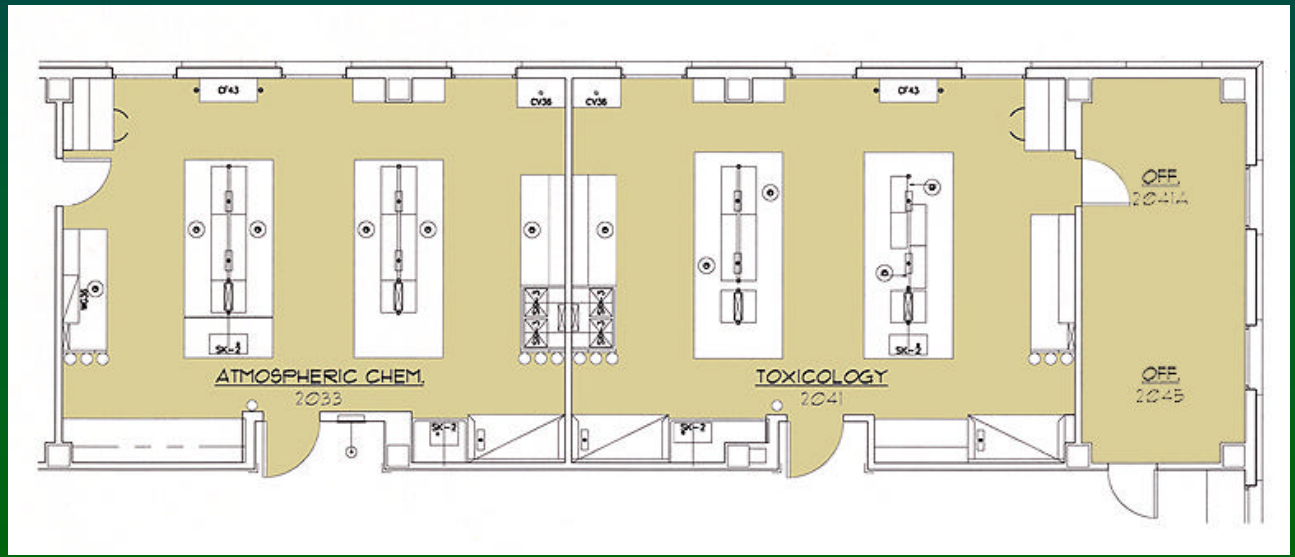
FOURTH FLOOR


BUILDING SECTION / ELEVATION

*1 Laboratory 2 Laboratory Support 3 Office 4 Classroom*

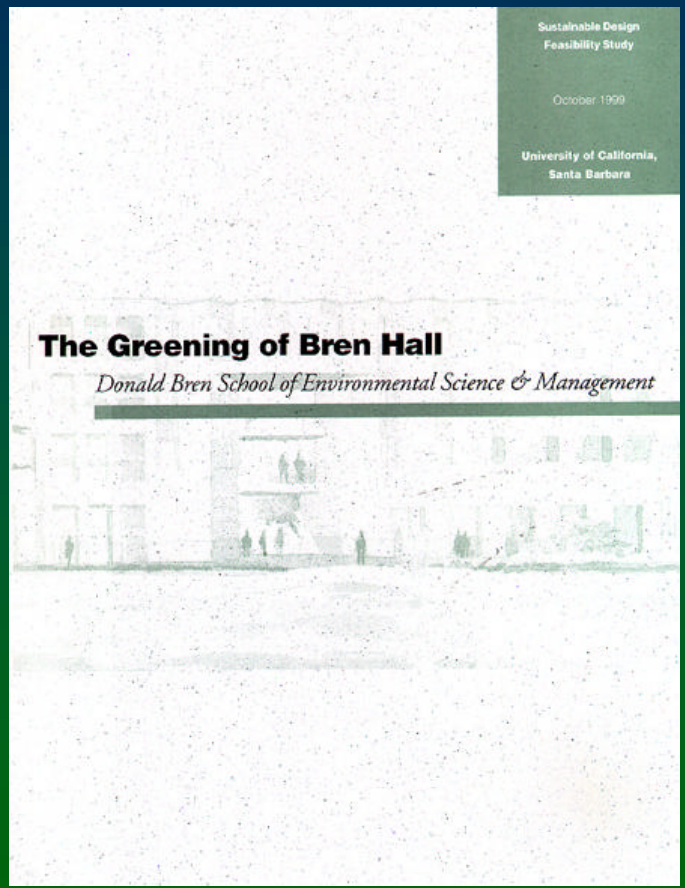
# LABORATORY PLANS



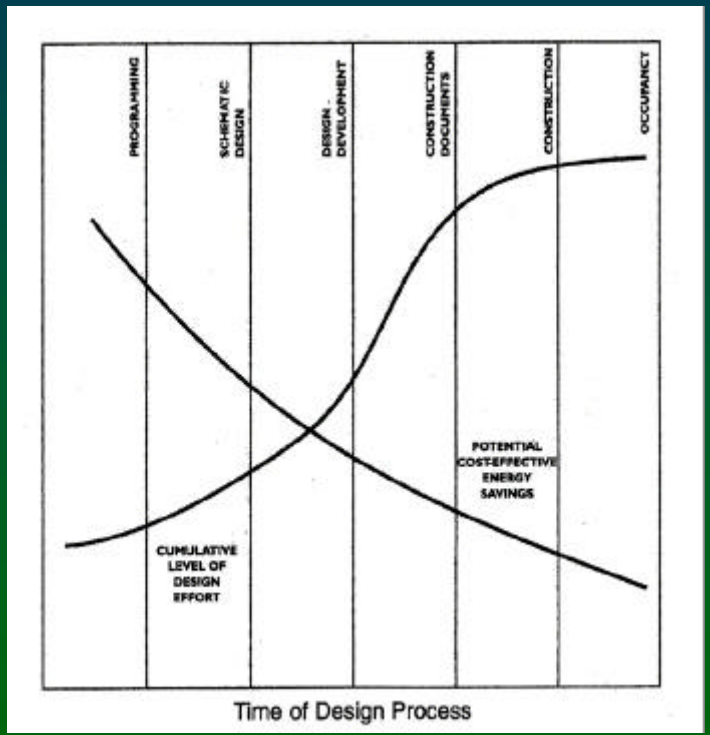
# Elements of design

- Site
- Energy
- Conservation
- Interior Environment
- Water



# Energy

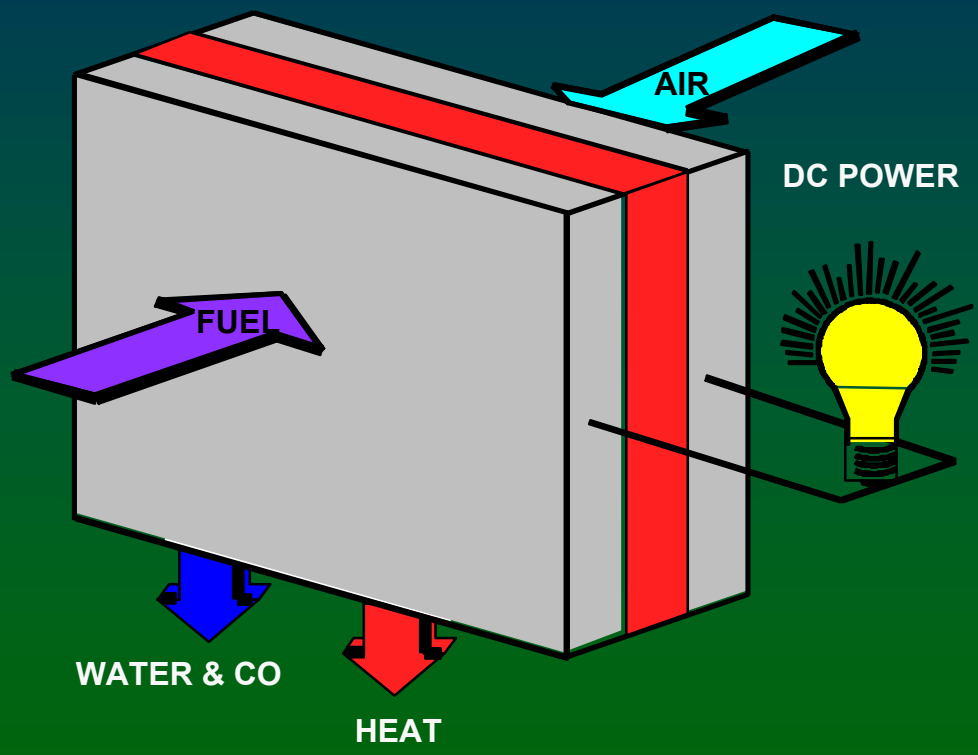
- Efficiency [VAV, etc.]
- Natural Ventilation, Light [Light Shelves, Sunscreens]
- Waste Heat Recovery
- Renewable and Alternative Energy
- Daylighting Controls



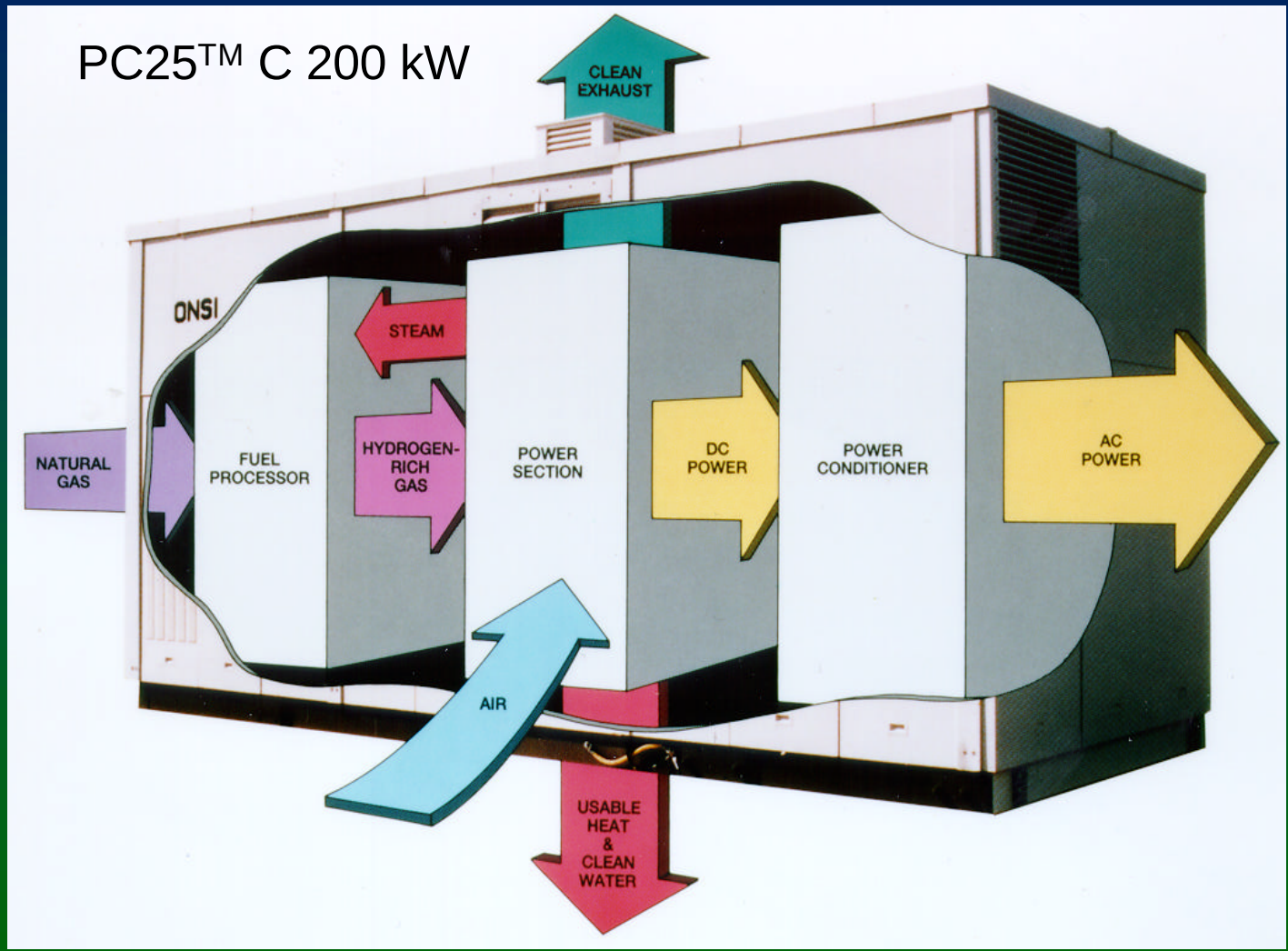
# Fuel Cell

*Like a battery that never runs down*

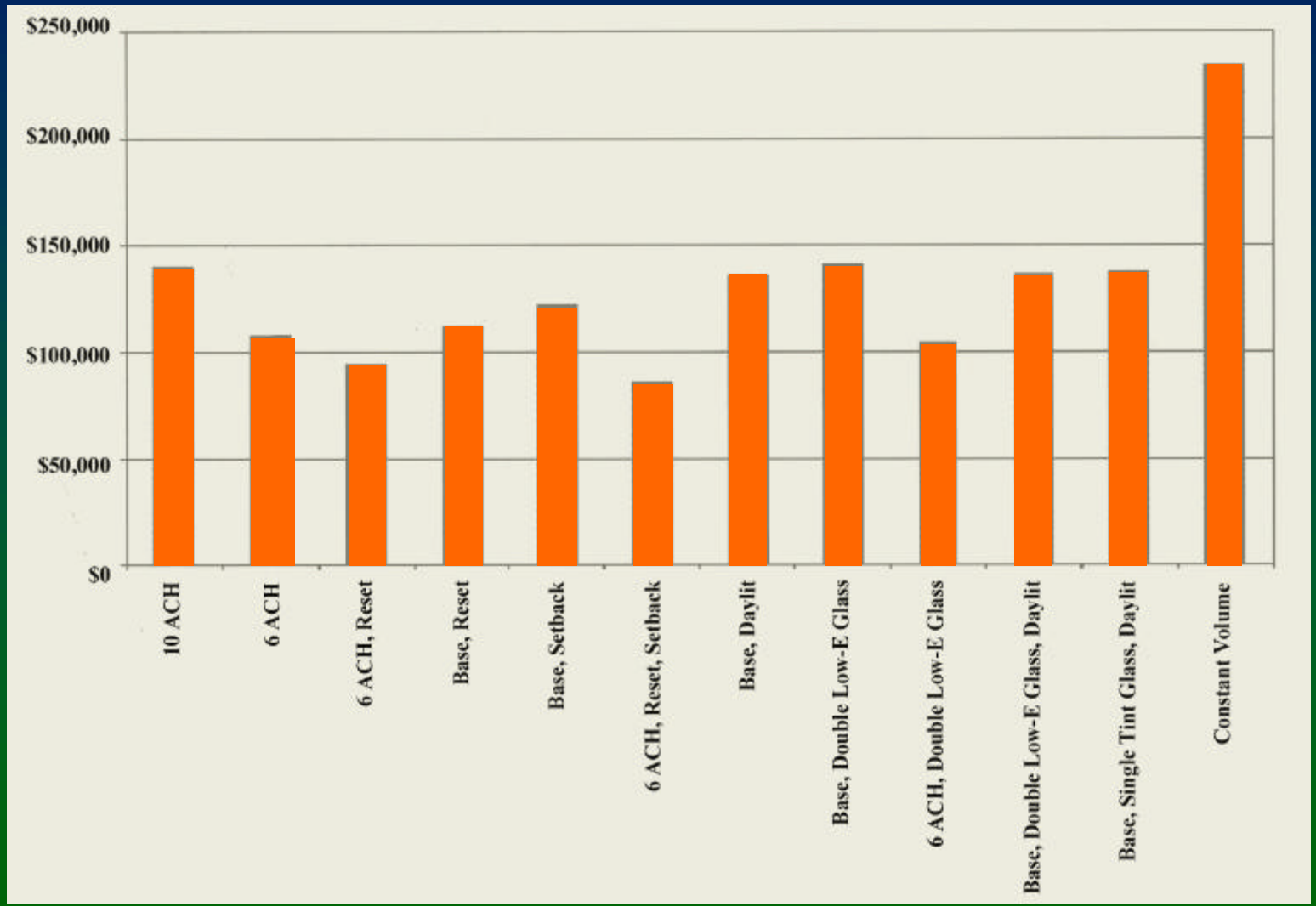
- High Quality Electricity
- Noise Free
- Pollution Free



# Fuel Cell Power Plant



# Energy Operating Costs



# VAV

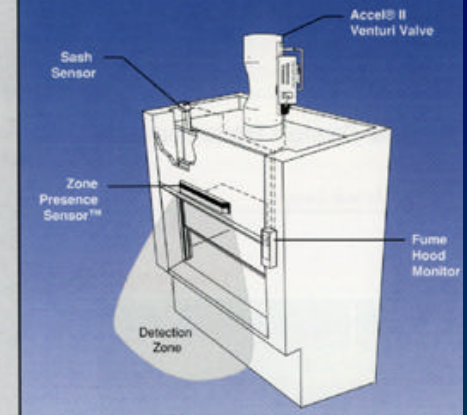
## Usage Based Controls

- Improves safety
- Reduces construction cost
- Saves energy
- Eliminates costly maintenance
- Reduces system commissioning time
- Integrates easily
- Avoids need to re-balance

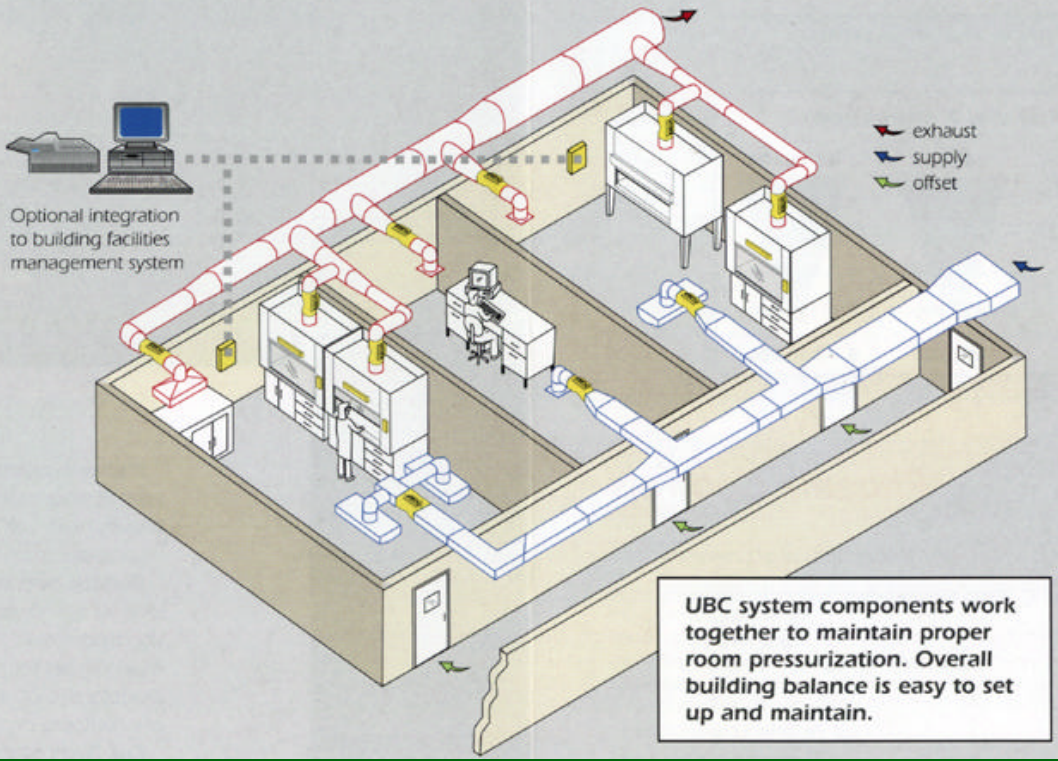
# The Safe Choice for Laboratory Airflow Control.


Operator present: full airflow


No operator present: reduced airflow

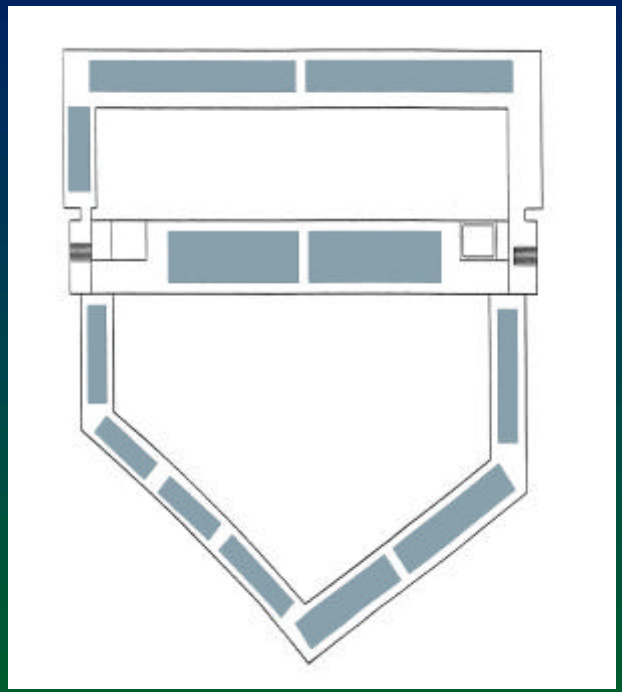


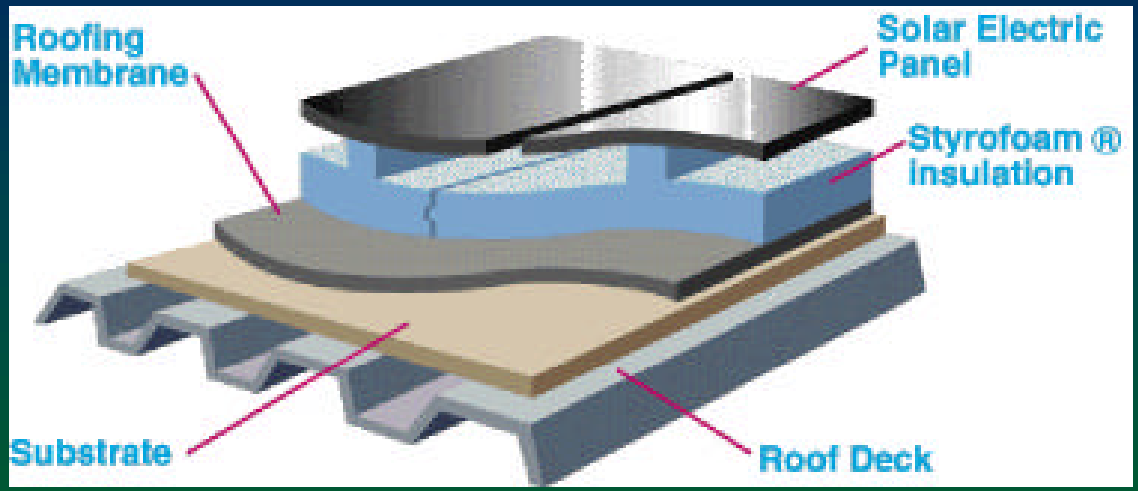

Usage Based Controls™ System Components




UBC system components work together to maintain proper room pressurization. Overall building balance is easy to set up and maintain.

# Photovoltaics






# Title 24

| No | Case | Total Source Energy per sqft kBtu/(sqft-yr) | Process Source Energy per sqft kBtu/(sqft-yr) | Adjusted Source Energy [1] per sqft kBtu/(sqft-yr) | Percent Below Title 24 % | Electrical Peak Demand kW | Lighting Site Energy kWh/year | Annual Site Energy Use Electricity kWh/year | Annual Site Energy Use Natural Gas Therm/year |
|---|---|---|---|---|---|---|---|---|---|
| 0 | Standard Design | 271.4 | 30.0 | 241.4 | 0.0 | 667 | 369673 | 1,991,459 | 42,839 |
| 1 | Natural Ventilated Offices | 255.3 | 30.0 | 225.3 | 6.7 | 609 | 369673 | 1,876,031 | 40,039 |
| 2 | Premium efficiency variable Pumps | 267.3 | 30.0 | 237.3 | 1.7 | 665 | 369673 | 1,968,907 | 41,392 |
| 3 | Lab Fume Hood VAV | 228.2 | 30.0 | 198.2 | 17.9 | 640 | 369673 | 1,781,572 | 25,053 |
| **10** | **First Design as a Comb of 0,1,2,3** | **211.2** | **30.0** | **181.2** | **24.9** | **583** | **369673** | **1,667,088** | **21,366** |
| | **Strategies based on First Design** | | | | | | | | |
| 12 | Lab Fume Hood sensor | 210.6 | 30.0 | 180.6 | 25.2 | 582 | 369673 | 1,668,453 | 20,603 |
| 13 | Additional Chiller Pump | 205.7 | 30.0 | 175.7 | 27.2 | 582 | 369673 | 1,617,775 | 21,345 |
| 14 | Daylight Control within Office wing | 205.1 | 30.0 | 175.1 | 27.5 | 559 | 312804 | 1,610,034 | 21,633 |
| 17 | High eff. Chiller+Tower Combinat. | 206.0 | 30.0 | 176.0 | 27.1 | 565 | 369673 | 1,620,196 | 21,366 |
| 18 | High efficiency Boiler | 208.5 | 30.0 | 178.5 | 26.1 | 583 | 369673 | 1,667,511 | 18,841 |
| 19 | Reduced Lighting Power Density | 204.9 | 30.0 | 174.9 | 27.5 | 564 | 319787 | 1,607,597 | 21,649 |
| **30** | **Actual Design (0,1,2,12,13,14,17,18,19)** | **185.8** | **30.0** | **155.8** | **35.5** | **527** | **276821** | **1,469,107** | **18,468** |

[1] Excludes Process Energy


SB

# Lessons Learned

- Start early on greening! More cost effective
- Need a mechanism for factoring greening costs when project budgets are established
- Be alert to opportunities that exist and recognize what can be implemented without significant cost impact